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ABSTRACT

The process of studying text material is a criteria-related, self-directed form of reading involving three phases: prereading, reading, and postreading. Prereading consists of clarifying the criteria for study, constructing a study guide, and surveying the text to determine how much is already known, how interesting it is, and how difficult or time consuming it will be to learn what needs to be known. The reading phase includes extended reading, monitoring understanding of text meaning, and remediating important comprehension failures as they occur. Postreading activities augment what has already been learned and generate useful alternative texts, such as notes and outlines. Mapping can be part of this final stage and involves an elaborate outlining system which juxtaposes related ideas and indicates the nature of their relationship by a symbol system. (TJ)

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CENTER FOR THE STUDY OF READING

Technical Report No. 104

STUDY SKILLS AND LEARNING STRATEGIES

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STUDY SKILLS AND LEARNING STRATEGIES

In this chapter, the process of studying text material is viewed as a criteria-related, self-directed form of reading text. It is a form of reading unlike reading a novel for entertainment or reading the newspaper to pass time on a commuter train. Rather, it is a form of reading in which specific information must be gained by engaging a text or reference book in order to perform well on some future event, such as taking an exam, giving a speech, or writing a paper.

The other important feature of studying, as it will be discussed in this chapter, is that it is student-directed. The student is the prime agent in deciding when and how the study sessions should proceed. In contrast, other types of studying, such as teacher-directed, computer managed or programmed instruction, provide the student with decisions about what-to-do-next.

To help describe the process of studying, the concept of metacomprehension is used frequently in this chapter. According to Flavell (1978), a broad definition of metacomprehension is "knowledge or cognition that takes as its object or regulates any aspect of any cognitive endeavor." For the needs of this chapter, however, some of the more specific characteristics of metacomprehension, e.g., cognitive monitoring and comprehension failure, are crucial. These are key concepts of student-directed studying, since students must reliably monitor their own acquisition, maintenance, and production of knowledge. The notion of metacomprehension is woven into each of the three major sections in this chapter which discuss the Pre-reading, During Reading and Post-reading activities involved in the process of studying.

Stage I: Pre-reading Activities

The first stage of Pre-reading activities begins when the student has resolved some of the motivational aspects of studying (e.g., Do I have time to study? Am I too upset to study? Are there easier ways to learn this material?), and is convinced that the textbook must be engaged in order to learn. Once the decision has been made to engage text, the student must clarify the criteria associated with the study session. The following two sections discuss some of the processes that students can apply to aid them in clarifying criteria.

Clarifying the Criteria and Objectives of Studying

While studying can occur for many diverse reasons, most often students engage in textbook studying to prepare for an examination. Also, textbook studying is seldom isolated from other instructional components of an educational system, such as lectures, computer-assisted instruction, laboratory work, and discourse with classmates and teachers. In the Pre-reading stage, the prime task of the student is to apply knowledge gained from these other instructional sources in order to help specify as clearly as possible the nature of the forthcoming examination. In other words, the students need to determine what topics will be tested, as well as the expected levels of understanding of each topic.

The most readily available sources of information to help students decide on the nature of the forthcoming examination are lecture notes, course guides and objectives, and copies of previously administered exams. The student's job is to organize these materials so that they will be maximally useful at later stages in the study session.

One suggested organizational technique is to develop a study guide upon which subject matter entries can be made as they are encountered. We

have found it useful to have one sheet set aside for all potential test items which will require students to name, describe, define, or give examples and applications. For example, when an instructional objective states that the student will be able to identify Copperheads, describe the Battle of Shiloh Church, or when a test item requires the student to list two important safety precautions when using an arc welder, then the student would write Copperheads, Shiloh Church and arc welder-safety on the study guide.

On a second page labeled "Comparisons," the student lists those topics which require a "compare and contrast" level of understanding. Items from lists of objectives and tests such as, "Discuss the effectiveness of Davis and Lincoln as military leaders," or "What was the major difference between the United States and the Confederate States constitutions?" would be entered onto the study guide as "Davis vs. Lincoln" and "U.S. vs. C.S. constitutions."

Onto a third study guide page would be entered those items which have a temporal, procedural, or causal relationship. Items such as, "Why did the people in the South mourn Lincoln's assassination?" "Why should all arc-welding hardfacing be done in a flat position?" or, "Before checking to see that the voltage is zero, what should be done?" would be entered as "Lincoln's assassination → South mourning"; "flat position → hardfacing"; and "→ voltage is zero."

Finally, a fourth study guide page would contain those items which would not fit conveniently onto the first three. Those items which require complex tasks such as analyzing, evaluating and critiquing would be included on this fourth page. Our preliminary work with this technique indicates that a student can translate 40-items from a multiple-choice

text onto these worksheets in about 15 minutes. We believe that this is not an unreasonable amount of time to spend on this task.

In summary, this Pre-reading activity requires that the students translate items from tests, lists of objectives, and lecture notes into topic entries and write them on the proper study guide page. Constructing these worksheets is a technique that aids in organizing the pertinent information related to the study criteria. Another valuable source for gathering information is the textbook. The next section describes how that procedure works.

Surveying

It is easy when reading some of the most influential "how-to-study" literature (Robinson, 1970; Pauk, 1974) to be lulled into thinking that surveying is a straightforward, rather non-involved process. Many authors suggest that students read the title, read the subtitles, look at the pictures, read the summary, etc. while quickly turning from page to page throughout the chapter. Seldom are these suggestions described in enough detail to inform the student on what information is supposed to be found in the title, the pictures or the summaries.

In an effort to gain more insight into surveying and to begin formulating a first-order model of this process, we gave twelve skilled readers a chapter each to study in preparation for a later event, such as taking a test or attending a lecture. We contacted each studier in advance and asked them to set aside approximately a one-hour block of time in an effort to make the task demands as realistic as possible. To start the study session, they were told that they should study in preparation for either a test to follow, or to attend a lecture. Then the text was given to them and their initial behaviors were observed. Specifically, we wanted to know whether or not they would attempt any type of survey

activity; and second, we wanted to know more about the cognitive processes involved in the surveying activity. The following model was generated from this source of observational and self-report data.

We discovered that virtually every one of these subjects attempted some form of survey. The shortest survey was only 10 seconds, and the longest was in the range of 15 minutes. During these relatively short periods of interaction with the text, a number of very complex behaviors and procedures took place. We tried to capture the gist of most of our observations and student reports in the three questions which students seemed to be attempting to answer as they surveyed. These questions are: (1) How much do I already know about this topic and text? (2) How interested am I in this topic and text? and (3) How difficult or time-consuming will it be for me to learn what I need to know from the text? The evidence that students were seeking in order to help answer the questions came from a number of sources, and our categorization of these sources leads us to the next descriptive part of the model.

The first level of information that students attended to were the salient, information-rich, non-sentence parts of the text chapter. These parts include the title, subtitles, marked words, highlighted sections, pictures, charts, graphs, maps, and reference lists. Most textbooks make it easy to quickly locate such information with only a glance at each page. A brief pass through a chapter in which the student inspected only these types of information typically took two minutes or less. The second level of information that these students attended to was information-rich portions that are in predictable places in the text and can be located rapidly. This kind of information includes introductory and summary paragraphs, the first and last paragraphs in the subsections, and the first

sentence of any paragraph. To engage in this second level of information gathering required ten to fifteen minutes in a typical chapter. In a third level of activity during the survey, students engaged in selective reading of larger parts of the text. For example, they may have read most of a subsection, or perhaps, several consecutive paragraphs.

The process of using these three levels of information to help answer the three "How-I" questions, is a very dynamic and complex one. Seldom did a student survey using information only at one level. For example, almost no one read only the title, subtitles and inspected the charts, figures, graphs, etc. Instead, the students moved very rapidly among the several levels of information. The movement among the levels, however, did not seem to be random, and the following model accounts for some of that behavior.

(1) The students initially engage Level 1 in order to answer the three questions.

(2) They will move from Level 1 to Levels 2 and 3 if they cannot reliably answer the three "How-I" questions by using Level 1, or the material is particularly interesting to them.

(3) The students will move from Level 3 to Levels 1 and 2 if they are able to reliably answer the questions, or if the text becomes less interesting.

(4) If the text is not formatted to facilitate using Levels 1 and 2, i.e., the text has only paragraphs with no headings or format markings of any kind, then the surveying process breaks down and the students try some other strategy, such as starting at the beginning of the passage and carefully reading each paragraph.

In addition, our observations have led us to believe that answers to the three "How-I" questions can be used to make predictions about how well the study session will proceed. The study session will stop after surveying: (1) when the subject already knows the content, and/or (2) when the subject is very uninterested in the topic, and/or (3) when the time required to learn the text greatly exceeds the time available for study. Also, the study session will probably be of limited duration when interest in the topic and text is, at best, low and difficulty of the topic is high. The study session will probably proceed smoothly under the following conditions: (1) when at least some, but not all, of the text material is already known, (2) when the topic is somewhat interesting, and (3) when the time estimate to learn the required material is low to medium.

In many respects the process of surveying is much more complex than that of reading and studying the text itself, as described in the next section. Stage II. Skilled students use rich (but terse) information from the text and from their own knowledge of the world to make decisions about their own level of understanding and attitudes toward the text and topic. Skilled readers can do this in a very short period of time, usually on the order of a few minutes.

Stage II: During Reading Activities

After clarifying the nature of the studying outcomes and constructing a study guide, reading extended text can begin. Frequently, there is a distinct break in the "flow" of studying behavior between Stages I and II. That is, students stop looking rapidly through the chapter as in surveying and start at the beginning to read each section. Sometimes, however, students never move out of Stage I; this happens when the studying criteria are explicit enough to enable a student to rapidly locate and read the

relevant sections of text while surveying. Occasionally, for example, the charts and graphs will contain all of the necessary information; this is often the case with technical manuals. When the situation arises in which students must engage larger chunks of text and must proceed to Stage II, a metacomprehension model of studying is proposed to help account for the diversity of activities which occurs.

In this model the student engages in a sequence of instructional episodes. Most episodes include the following components: (1) information gathering, (2) student responding, (3) response judging and feedback, and (4) making decisions concerning what-to-do-next. An example of a short episode would be a frame in a programmed instruction text. In a programmed text a short chunk of information is presented, a question is asked, and the student provides an answer which can be compared with a "preferred answer" printed elsewhere in the text. Feedback and directions about what-to-do-next are provided. Thus, a programmed text frame would be a prototypic example of a short instructional episode where only a limited amount of metacomprehension is required.

As previously mentioned, the focus of this chapter is to consider studying as a self-directed form of instruction. To study effectively the student must know when and how to use each component of the model, and to do this well requires that the student be a good metacomprehender. Some forms of instruction, such as teacher-directed or computer-managed instruction, use other techniques to substitute for metacomprehension. For example, students engaged in traditional computer-managed instruction do not often have to ask the question, "Do I know if I understand this material?" During each episode the computer informs the students whether or not they understand the material. The next sections describe the way

in which the four components apply to studying, along with a discussion of some relevant research.

Information Gathering

An instructional episode begins when the student starts reading to extract meaning from sentences and paragraphs in a more or less sequential order. When students have an orgainzed study aid, such as the study guide described earlier, it can be used to help generate text-specific search markers, i.e., reference points where reading should start and stop. In other words, students can be more selective in what information they choose to process.

The skill of selecting important text sections to read carefully is a very important one when considering the sheer information load of a text chapter. For example, the number of so-called idea units in a typical chapter of text is minimally 50 per page. To calculate this we used a conservative technique, similar to one for calculating pausal units (Brown & Smiley, 1977), in which we defined an idea unit as that verbage bounded by punctuation marks, conjunctions, and/or infinitive phrases. Commas which were used to set off members of a list or a city-state combination were not used. Using these data, a 30-page chapter would have, at a minimum, about 1500 pausal units or ideas.

To determine how students collect information from extended text, Reynolds, Standiford and Anderson (1978) had college students read a text at a computer terminal in an inserted question research paradigm. Using the terminals allowed measurement of reading times on short segments of material. They found that the question groups performed better, relative to controls, on posttest items that repeated inserted questions, as

well as on new posttest items from the same categories as the inserted questions. Analyses of time data showed that there was no overall difference in reading times between the two groups--those who had inserted questions and those who did not, but subjects who received inserted questions spent more time on the parts of the text that contained information of the type needed to answer the questions. In other words, students modified their information gathering processes in accordance with the task, as defined by the inserted questions.

In another experiment, Baker (1978) presented passages containing designed confusions, i.e., contradictions of information involving main points of the passage or involving passage details, to subjects at a computer terminal. After reading the passage, subjects were given a series of on-line questions to assess their awareness of the confusions. They were first asked to decide which of two alternatives was most consistent with each passage, where the alternatives were paraphrases of either the contradictory target or its corresponding non-confusing control statement. Depending on which answer subjects gave, they were automatically branched by the computer to further questions probing their interpretations of the passage.

Results showed that subjects spent more time reading paragraphs with contradictions than those without contradictions if the contradiction involved a main point. However, when the contradictions involved passage details, subjects spent less time reading the paragraphs in which the contradictions appeared than those without contradictions. Thus, subjects were sensitive to the contradictions and therefore altered their reading behaviors in an unexptected but defensible way. For example, it appears

that the subjects did in fact notice the contradictions on detail items, but decided to gloss over them rather than take additional time to resolve them.

This section on information gathering is not meant to be an exhaustive review but rather an attempt at illustrating some of the variables which affect this process. Thus, it is rather clear that the nature of the task demands as well as the interaction of clarity of presentation and importance of information influence information gathering strategies.

Student Responding

This second component in an instructional episode requires that the student stop gathering information and engage in a response-demand event. In general, two types of mechanisms can interrupt the information gathering process: (1) a response-demand event initiated by either the student or teacher (human or computer), and (2) the Automatic Monitoring Mechanism (AMM) which provides students with "noises" concerning their studying comprehension, called "clicks" of comprehension and "clunks" of comprehension failure. This notion will be elaborated later.

A major, well researched form of response-demand event is the use of adjunct questions. The so-called direct effect of adjunct questions occurs when students receiving adjunct questions performed better on criterion questions which are identical to those used in the adjunct form than students in a read-only condition. There is also an indirect effect of adjunct questions: a superior performance by students receiving adjunct questions on new criterion questions which were not used in the adjunct form compared with the performance of students in the read-only condition.

Recently Anderson and Biddle (1975) reviewed literature on adjunct questions and concluded that the use of adjunct questions generally has a

facilitative effect on learning from prose. When the questions are placed after the text read by the students, they have a significant facilitative effect on the repeated items and on the new items, showing direct and indirect effects. When adjunct questions appear before the text the students are to read, they have a positive direct effect, but a negative indirect effect. In addition, the closer the questions are physically located to the information to which they refer, the higher the performance when those questions are repeated later. Moreover, when questions are grouped together after even lengthy prose, such as at the end of a chapter in a textbook, they can have a pronounced direct effect. When students are required to provide an overt answer to the adjunct questions, there are more consistent positive direct and indirect effects than when students are required to make only a covert response. When the adjunct questions are higher level questions, i.e., they require the student to go beyond the surface meaning of the text in order to answer the question, they have direct and indirect effects. The point is rather clear that adjunct questions can play a strong facilitative role in studying and learning text material.

In a related line of research in which students are required to engage in a response-demand event, results from recent investigations on student-generated questions by Frase and Schwartz (1975), Schmelzer (1975) and Duell (1977) are encouraging. These researchers present four studies which show that when students (high school and older) formulate questions during study by either writing them down or verbalizing the questions to a friend, they scored significantly better on a posttest than students who studied using various other controlled techniques.

André and Anderson (1978) report another study using student-generated questions in which some of the controls and techniques used by the previous authors were relaxed. Duell (1977) required students to generate multiple-choice items rather than constructed-response type items. Frase and Schwartz (1975) used text material which was so factually dense that virtually all of the students' questions were about specific facts. André and Anderson (1978), on the other hand, taught students to generate open-ended questions concerning the main idea of each paragraph as they read it.

In a first experimental study, a random, selected group of students was trained to use the question generating tehcnique. Another group of students served as a control; these students were given the same series of training passages to practice on as those given to the experimental group. However, this control group was not told specifically how to study the materials. On a second day, all students were given a new passage to read and study, followed by a criterion test which measured students' knowledge of important outcomes. Results from this study showed that there was a significant interaction between students' verbal ability and the effects of the strategy they employed. Specifically, the higher verbal ability students showed no significant gain by using the student-questioning technique over whatever other techniques they employed. The difference was seen in the students with less verbal ability; they showed a significant gain by using the questioning technique.

In a second study, the same two treatments as used above were employed with the addition of a third. This additional group was not trained to use the questioning technique, as was the experimental group, but the untrained students were asked to try the technique on the criterion

materials. Results from this study show that both groups using the questioning technique scored higher than their control group. Results also reveal a Treatment by Ability level interaction, indicating that the lower verbal ability students benefitted more from the treatment than did the higher verbal ability students.

Another finding from these studies shows that when students constructed a good question about a main point, the probability was twice as great as opposed to when they were not able to construct one, that later they could correctly answer a question on the criterion test concerning the main point. This finding is viewed as evidence that the quality of students' questions can serve as a comprehension monitoring index for the student at an important time in the study process when the student can take action to learn the material better. That is, if the student cannot easily generate a good question, then it may be necessary to reread the text section or consult another source. In addition, this technique provides the student with a record of questions that can be studied in preparation for a later test.

Of course, many students engage in the more familiar types of response-demand events such as notetaking, underlining and outlining. There is a long history of research on the effects of these kinds of activities and, in general, they are not very facilitative (see Anderson, 1978). However, these activities are shown to be facilitative if they generate an extensive alternate form of the text which can be used for future reference because the original source (1) will not be available later, (2) is very lengthy, and/or (3) is not appropriately organized with reference to some criterion. A landmark study by Barton (1932) illustrates this point. He taught ninety-six high school students from two schools the fundamentals of

outlining. The prime objective of the instruction was to teach the students to find main, subordinate, coordinate, and irrelevant points in each paragraph. Students applied the outline strategy to subject matter contents of geography, American history, and ancient history. Test performance of the students who used the outline strategy for a semester was significantly higher than test performance from a matched group who had a similar instructional program excluding the outline training. This is the most impressive study in the literature and demonstrates, with few reservations, the beneficial effect of a student generated study aid.

In summary, there is evidence that when students stop reading and respond to questions, generate questions or construct extended outlines or paraphrases, learning from prose is facilitated. However, pausing briefly to underline or to jot down brief notes typically are not highly effective forms of response-demand events.

Another mechanism which can interrupt students while reading text is the so-called Automatic Monitoring Mechanism. It is called "automatic" because it seems to operate at a subawareness level and the student is only aware of its operation after it has made its noises, i.e., clicks and clunks. In an initial investigation of the Automatic Monitoring Mechanism, we observed and questioned graduate students as they engaged in study. While we were aware that this technique would intrude on and possibly disrupt the study process, it seemed to be a good method for indexing many of the otherwise covert processes. To date we have collected interview data from eight students. Our most heavily constricted technique required each student to read aloud; to predict the content of each paragraph prior to reading it in depth; to summarize the paragraphs after reading them; and, to relate all other thoughts concerning the study

session. Our most lenient technique required each student to study normally and to place a question mark beside any section of text that was confusing and/or slowed down or stopped the reading process. After studying the text, all students were given a test over the material and the nature of the question marks and/or notes was discussed in a posttest interview.

The following observations are results of those interviews. (1) The first technique discussed above--heavily constricted technique--was so highly interactive that it seemed to become a learning strategy in itself; i.e., the students seemed to learn more from the exchange with the experimenter than from the text itself. (2) During the post-study interview, students could discuss in detail the nature of the question marks that they entered on the text while studying. Consequently, we were not required to interrupt the study process by requesting reports from students. (3) Students have a rather well established study strategy that is not easily modified by telling them about various task demands or types of studying materials. (4) Students can impose temporary meaning on novel words or phrases encountered in a text with the intention of clarifying the meaning later, if important, or ignoring it if unimportant. In general, students employ extremely sophisticated strategies concerning the semantic importance of text that they encounter. For example, words used in footnotes or words not essential to understanding the gist of a sentence were usually considered unimportant, and their meanings were seldom verified in a dictionary or glossary. (5) Students had trouble remembering to write the question marks when they were confused. They reported that having to remember placing the question marks interfered with studying. (6) Students exhibited many emotional

behaviors, i.e., smiles, frowns, muscle tension, perspiration, and a general emotional fatigue after the study session.

In conclusion, we saw these study sessions as a series of very sophisticated cognitive and emotional processes which are difficult to monitor and are generally below the student's level of awareness. Occasionally these processes reached an awareness level in the form of the previously mentioned click of comprehension or clunk of comprehension failure. Clicks were often accompanied by feelings of well being and clunks were accompanied by feelings of tenseness and/or mild anxiety.

Another effort (Baker, 1978) to investigate the Automatic Monitoring Mechanism consisted of a research plan with two phases. To implement the first phase of the research plan, ten three-paragraph passages on world history topics were written with deliberate confusions introduced into the middle paragraph of each passage. Types of text confusions included: (1) pronouns with indefinite referents, (2) linguistic markers incorrectly signaling the nature of the text that follows; e.g., using "therefore" when "in addition to" is appropriate, and (3) presentation of new information relating to a previously developed topic which is inconsistent with earlier information. Each of the three types involve either a main point or a detail in the passage. Thirty-three college students were instructed to read the passages as editors might and to put a question mark by and/or explain any confusions they detected. Hopefully, these instructions encouraged the students to engage in a high degree of metacomprehension. Results showed that only six percent of the students were able to detect all of the planned confusions. Furthermore, the average percentage of the confusions detected per student was only thirty-four percent, which was lower than expected. Two plausible explanations were posed to account

for this low percentage: (1) Some of the passages dealt with content that was difficult to understand (such as some of the philosophical aspects of history), which diminished the salient features of the planned confusions; (2) Students seemed able to impose plausible alternate meaning onto the target areas of text, and in so doing, apparently solved any confusions they might have experienced.

In the second phase of the research plan, 26 college students were instructed to read the passages described above and were also told that they would receive a subsequent comprehension test over the material. The test had one item (the target item) related to the confusion and two items from other places, for each of the ten texts. These students were not informed that any of the texts had planned confusions.

Results from the comprehension tests showed that the presence or absence of confusions appeared to have no effect upon the performance of the non-target items. When reading the target items, or the "confusing" paragraphs, fifty-one percent responded with a recognized verbatim response from the passage, (which is evidence that the inconsistency was not noticed and/or adequately resolved), while forty-five percent recognized the "correct" answer (which is evidence of detecting an inconsistency). Four percent chose a third alternative which was neither verbatim from the text nor a "correct" answer.

If subjects read a "consistent" passage seventy-six percent responded with the correct alternative, eighteen percent gave the "inconsistent" choice, and five percent chose the other alternative. In general, subjects responded more frequently with verbatim information when it was consistent with the passage (76%) than when it was inconsistent (51%). This difference indicates that many students were aware of the confusions

in the text (at some level of processing) whether or not they could state so explicitly.

In a second study of Phase Two (briefly discussed earlier under Information Gathering), 37 subjects were presented a subset of the passages used previously: two passages contained confusions, e.g., contradictions involving the main point of a paragraph, while two involved contradictions about passage details. The materials were presented sentence by sentence on the PLATO computer-assisted instruction system terminal screen. The students controlled the amount of time they spent on each sentence. They were also given the opportunity to "move around" in the text; that is, they could look back or look ahead at any section of the passage when they so desired.

Another manipulation in the experiment involved the position of the contradictory target statement relative to its disconfirming context. In the case of the main point passages, the contradictory statement was either the first or last sentence in the paragraph. The remaining sentences provided information that went against this statement. For detail passages, the context for the contradiction was but a single sentence, and both were embedded within the paragraph. Thus, the manipulation involved reversing the order of those two sentences. It was hypothesized that patterns of reading behavior depended on the position of the contradiction.

After reading the passages, subjects were given a series of on-line questions designed to assess their awareness of the contradiction. They were first asked to decide which of two alternatives was most consistent with each passage. The alternatives were paraphrases of either the contradictory target or its corresponding consistent control statement. Depending on which answer subjects gave, they were automatically branched

by the computer to further questions probing their interpretations of the passages.

A significant result of the study was a Paragraph Type (main-point vs. detail) by Target Type (contradictory or consistent) interaction. Subjects spent more time reading the entire paragraph when a contradiction was present if the contradiction involved a main point. However, on the detail passages, subjects spent more time reading the paragraph when the target statement was consistent rather than contradictory. This same pattern was also observed for (1) the amount of time spent on the target statement alone and (2) for the number of lookbacks on the entire paragraph. Thus, the contradiction manipulation had the anticipated results only on main-point paragraphs. One plausible explanation is that subjects did in fact notice the contradiction on details but decided to gloss over it rather than attempt to resolve it. Thus, they actually spent less time studying the material than when it was written to make perfectly good sense.

Differences between main point and detail passages were also apparent in the question-answering data. Overall, accuracy was greater on main-point questions than detail, where accuracy is defined as the correct selection of the consistent, noncontradictory alternative. This held true regardless of whether the passage was consistent or contradictory. However, subjects were more accurate when they had read the consistent passage. This outcome is not at all surprising since even if subjects had detected the contradiction, there would be a conflict between what they actually read and what the correct answer should be.

Finally, analysis of the time required to make a correct response showed that subjects required considerably more time answering detail questions when a contradiction was present. However, there was little

difference in response times on main-point questions, suggesting that if subjects had resolved the inconsistency and identified the real main idea of the paragraph, they did so during initial reading. This interpretation is consistent with the observed differences in reading behavior on main-point passages.

As is obvious from the above accounts of research on the Automatic Monitoring Mechanism, the discovery process is just beginning. The research difficulty is compounded by the fact that many students are generally unable to keep a record of their monitoring acitvities without having the record keeping interfere with the monitoring. Consequently, we have had to use the indirect technique of having students study materials with planned confusions. To date, we have only a few results, all of which lead us to believe that the Automatic Monitoring Mechanism is quite complex, perhaps more so than we anticipated. It is able to distinguish between confusions which are potentially serious to successful comprehension, such as those involving a main point, and less serious ones, such as those involving passage details. However, confusions involving the improper use of transition words, e.g., however and therefore, never seemed to trigger the mechanism. The research paradigm, however, seems solid and it should have additional payoff in the future.

After the episode has been interrupted by either the response-demand event or the Automatic Monitoring Mechanism and some response has been noted, the student makes a decision regarding the appropriateness of the response. Making this decision is, at best, a difficult task and a realistic decision depends, to a large extent, on the explicitness of the criteria. After making the decision, rules concerning what-to-do-next must be applied.

Decisions of What-to-Do-Next

Outlined below is the tentative model of how skilled readers manage this what-to-do-next question. These conditional statements are the consequence of a logical analysis, based on interview data, of the actions students take when they fail to comprehend.

1. If a reader reads something that is not understood, some immediate action may occur or the information may be stored in memory as a pending question.
2. If the reader stores it as a pending question, a possible meaning (usually one) may be formulated, which is then stored as a tentative hypothesis.
3. If the reader forms a pending question, reading continues.
4. If a triggering event (i.e., too many pending questions, or repetition of the same pending question) occurs after the reader forms the pending question, some additional strategic action may be taken. By agreeing to take some strategic action, the reader may:
    a. Reread some portion of the text in order to collect more information that will either answer a pending question or form a tentative hypothesis that is related to a pending question;
    b. Jump ahead in the text to see if there are headings or paragraphs that refer to the pending question which might answer it;
    c. Consult an outside source (e.g., dictionary, glossary, encyclopedia, expert) for an answer to a pending question;

d. Make a written record of a pending question;

e. Think/reflect about the pending question and relate information that he/she has in memory;

f. Quit reading the text.

5. The reader may continue to read from the point in which comprehension failure was last encountered whether the strategic action is successful or not.

And so, the process continues in which the student manages episode after episode as each section of prose is processed.

Stage III: Post-reading Activities

In this stage, activities are employed by the student to enrich the learning that has already taken place, to increase the probability that what has been learned will be retained, and to generate alternate texts (e.g., notes and outlines) that will be useful when the material has to be studied again later.

In what Post-reading activities should students engage? In one sense, any of the organizational (outline, mnemonics), translational (paraphrases, generate questions), and/or repetitional (recitation, rehearsal) schemes can help students remember what they have learned. However, there is the chance that to engage in these schemes will burden the students with unnecessary busywork and they will gain mastery of information that is unrelated to the criteria. Fortunately, Weinstein and Dansereau are researching interesting strategies related to this particular phase of study which are discussed in other chapters of this book. These techniques have a very exciting potential of serving the student well during this stage of study.

At our Center, we have developed a new technique that is also potentially useful during this Post-reading stage. The technique is described as only "potentially" useful because it has not yet been field tested with a large population of students. However, the underpinnings of the technique seem sound and are worthy of discussion here.

As is apparent in this chapter, studying involves complex behaviors in which the student imposes meaning on text material through a series of self-directed instructional episodes. Studying is not seen as a series of mechanical steps, but rather an interactive process involving a student's prior knowledge, textbooks, study guides, etc. It is a process in which the student's comprehension of a text topic is expanded, sharpened, and made more relevant (or whatever else the studying criteria demand). When thinking about techniques to use in teaching students this complex process, a glaring hole in traditional study procedures is apparent. That is, there is no efficient way for students to concisely represent or record the meaning or the relationship among ideas found in lectures, notes, or text materials. Notetaking and outlining strategies are either too simplistic and insufficient for capturing the relationships, or they are so elaborate that employing them is an inefficient use of student time.

Consequently, a new technique was designed which stresses the importance of students' ability to link ideas together and to represent the nature of the relationship between the ideas. As an illustration of the inadequacy of the traditional techniques, outlining only enables students to detect which sets of ideas are subsumed under others; however, outlines do not provide an adequate framework for showing why they are subsumed. Are the subsumed items merely properties of the superordinate ones? Or, are they the outcomes of the superordinate items?

Some of our early thoughts about solutions to this problem came from an article by Hauf (1971), and from the work of John Merritt (1977) at the British Open University. Hauf (1971) describes a mapping technique in which students can organize the main ideas from a text passage without the usual constraints found in a formal outline. She advocates that the central idea be written near the middle of a note page and the subsidiary ideas be attached in a concentric fashion, resulting in a product that resembles a city map. The main difference between this technique and outlining is that it breaks down the left-to-right and top-to-bottom conventions used in formal outlines. However, while it allows students to represent more faithfully the often complex interrelationships among ideas in a passage, it, like the outline, offers no easy way of expressing the nature of the relationships among the ideas.

In addition, some interesting work by Merritt (1977) influenced the development of our new technique, also called mapping. Merritt and some of his colleagues proposed an interesting hypothesis: For many, if not most, text passages, there is a preferred technique for succinctly representing their meaning. For example, some passages are best represented by either a Venn diagram, a flow chart, a double-entry (check list) table, or a sketch. Data from the introspection activities of Merritt's team and from classroom students help support his hypothesis. Quite often students acting independently will design similar text representations from the same text passage. These outcomes suggest that there is some consistency in the way text can be represented. However, students would have to be taught a wide range of diagramming and charting skills in order to represent a variety of text.

Any new mapping scheme, then, should have the flexibility and simplicity of the one discussed by Hauf (1971), but also should be capable of succinctly representing a variety of relationships. Our new technique seems to have these characteristics. To use this new scheme requires that the student learn a set of relational conventions (symbols), which at the simplest level indicate how two ideas are related, but at a text level can show the complex relationships among many ideas. This scheme has seven fundamental relationships between two ideas, A and B: when, B is an instance of A, B is a property or characteristic of A, A is similar to B, A is greater or less than B, A occurs before B, A causes B, and, A is the negation of B. In addition, two special relationships show when idea A is an important idea, or a definition. The logical connectives and and or are also used.

An important feature of the maps, as illustrated in Figure 1, is that the shape of the map represents the organizational pattern of the ideas. For example, when the map based on text material is characterized by a series of embedded and segmented boxes, such as the box headed by "material possessions" in Figure 1, then the text is describing and giving examples of some,

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Insert Figure 1 about here

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perhaps, fundamental ideas. Chapters in many introductory level textbooks have these characteristic maps. On the other hand, when the map shows a series of boxes connected by arrows, such as those on the right side of Figure 1, then the text is concerned with a set of procedures (as in a technical manual), a chronology of events (as in a history text), or a causal chain of events (as in a concluding section of a chapter in a sociology text).

When and how often should students map ideas? Our experience with the technique is too limited to say for sure. However, we do know that

mapping entire chapters, while often an enlightening process, requires a great deal of time and realistically, the student learns more from the exercise than is often necessary to know about the chapter content. So, we are advocating that short maps be constructed for each important task outcome, i.e., one for each item that might be on a chapter test. Roughly this translates into one map for each entry on the study guide, as described in an earlier section.

Summary

The process of studying is a criteria-related, self-directed form of reading text. The activities in this process are discussed in three phases, Pre-reading, During Reading and Post-reading. Pre-reading activities require the student to clarify the criteria for study. This is accomplished by collecting previously administered tests, lecture notes and other evidence related to the criterion event, such as an examination, and then using these to construct a study guide by writing entries of key concepts from them onto appropriately labeled pages. Also during the Pre-reading stage, the student surveys the text in an effort to determine how much of the text/topic is already know, how interesting it is, and how difficult or time consuming it will be to learn what needs to be known.

The During Reading stage is characterized by periods of extended reading in which the students monitor their understanding of the text meaning and attempt to remediate any important comprehension failures as they occur. When additional key concepts are encountered in the text, they should be entered onto the study guide.

Finally, in the Post-reading stage, students employ activities to augment what has already been learned, to increase the probability that the learned material will be retained, and to generate useful alternate

forms of the text materials. Concepts which have a high probability of being tested on a subsequent exam, e.g., those with entries on the study guide, should receive special attention by mapping the related ideas. Mapping is an elaborated outlining scheme in which not only related ideas are juxtaposed, but the nature of their relationship is indicated by a symbol system.

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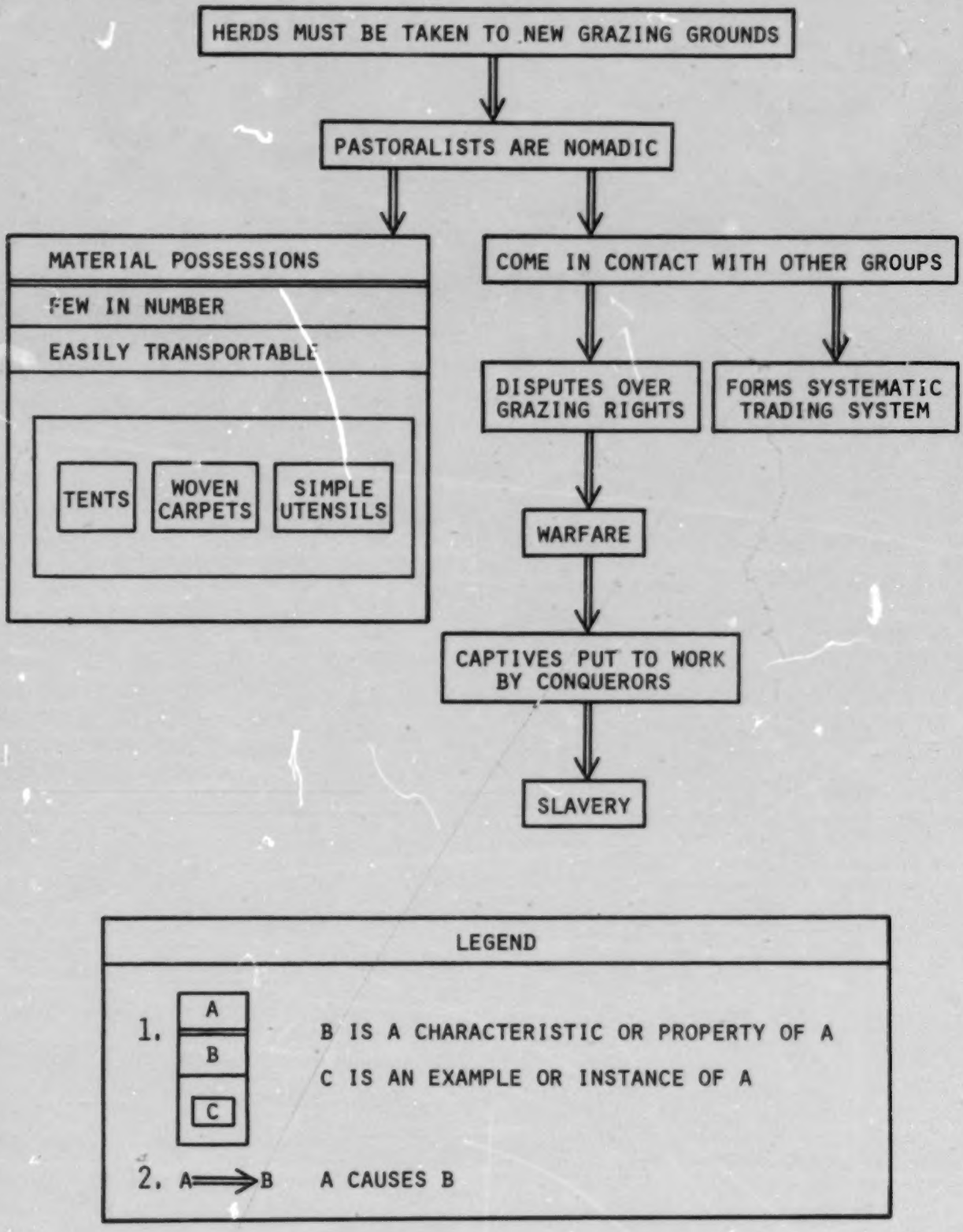

Figure 1. Map of text adapted from Sociology by Ian Robertson, New York: Worth Publishers, Inc., 1977 (p. 83).

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